

What is claimed is:

5 1. Apparatus for processing a multi-channel audio signal, the multi-channel audio signal having at least three original channels, comprising:

10 means for providing a first downmix channel and a second downmix channel, the first and the second downmix channels being derived from the original channels;

15 means for calculating channel side information for a selected original channel of the original signals, the means for calculating being operative to calculate the channel side information such that a downmix channel or a combined downmix channel including the first and the second downmix channel, when weighted using the channel side information, results in an approximation of the selected 20 original channel; and

means for generating output data, the output data including the channel side information.

25 2. Apparatus in accordance with claim 1, in which the means for generating is operative to generate the output data such that the output data additionally include the first downmix channel or a signal derived from the first downmix channel and the second downmix channel or a signal derived from the second downmix channel.

30 3. Apparatus in accordance with claim 1, in which the means for calculating is operative to determine the channel

side information as parametric data not including time domain samples or spectral values.

4. Apparatus in accordance with claim 1, in which the
5 means for calculating is operative to perform joint stereo
coding using a downmix channel as a carrier channel and us-
ing, as an input channel, the selected original channel, to
generate joint stereo parameters as channel side informa-
tion for the selected original channel.

10 5. Apparatus in accordance with claim 3, in which the
means for calculating is operative to perform intensity
stereo coding or binaural cue coding, such that the channel
side information represent an energy distribution or binau-
ral cue parameters for the selected original channel,
15 wherein a downmix channel or a combined downmix channel is
usable as a carrier channel.

6. Apparatus in accordance with claim 1,

20 in which the multi-channel audio signal includes a
left channel, a left surround channel, a right channel and
a right surround channel,

25 in which the means for providing is operative to pro-
vide the first downmix channel as a left downmix channel
and to provide the second downmix channel as a right down-
mix channel, the left and the right downmix channels being
formed such that a result, when played, is a stereo repre-
30 sentation of the multi-channel audio signal, and

in which the means for calculating is operative

to calculate the channel side information for the left channel as the selected original channel using the left downmix channel,

5 to calculate the channel side information for the right channel as the selected original channel using the right downmix channel,

10 to calculate the channel side information for the left surround channel as the selected original channel using the left downmix channel, and

15 to calculate the channel side information for the right surround channel as the selected original channel using the right downmix channel.

7. Apparatus in accordance with claim 1,

in which the original channels include a center channel,
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which further includes a combiner for combining the first downmix channel and the second downmix channel to obtain the combined downmix channel; and

25 wherein the means for calculating the channel side information for the center channel as the selected original channel is operative to calculate the channel side information such that the combined downmix channel when weighted using the channel side information results in an approximation of the original center channel.
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8. Apparatus in accordance with claim 1, in which the means for providing is operative to derive the first downmix channel and the second downmix channel from the original channels using a first predetermined linear weighted combination for the first downmix channel and using a second predetermined linear weighted combination for the second downmix channel.

9. Apparatus in accordance with claim 7, in which the first predetermined linear weighted combination is defined as follows:

$$Lc = t \cdot (L + a \cdot Ls + b \cdot C); \text{ or}$$

15 in which the predetermined second linear weighted combination is defined as follows:

$$Rc = t \cdot (R + a \cdot Rs + b \cdot C),$$

20 wherein Lc is the first downmix channel, wherein Rc is the second downmix channel, wherein t , a and b are weighting factors smaller than 1, wherein L is an original left channel, wherein C is an original center channel, wherein R is an original right channel, wherein Ls is an original left surround channel, and wherein Rs is an original right surround channel.

10. Apparatus in accordance with claim 1, in which the means for providing is operative to receive externally supplied first and second downmix channels.

30 11. Apparatus in accordance with claim 1, in which the first downmix channel and the second downmix channel are

composite channels being composite of the original channels in varying degrees, wherein the means for calculating is operative, to use, for calculating the channel side information, the downmix channel among both downmix channels, which is stronger influenced by the selected original channel when compared to the other downmix channel.

12. Apparatus in accordance with claim 1, in which the means for generating is operative to form the output data such that the output data are in compliance with an output data syntax to be used by a low level decoder for processing the first downmix channel or a signal derived from the first downmix channel or the second downmix channel or a signal derived from the second downmix channel to obtain a decoded stereo representation of the multi-channel audio signal.

13. Apparatus in accordance with claim 12, in which the output data syntax is structured such that same includes a special data field to be ignored by a low level decoder, and in which the means for generating is operative to insert the channel side information into the special data field.

25 14. Apparatus in accordance with claim 13, in which the syntax is mp3 syntax and the special data field is an ancillary data field.

15. Apparatus in accordance with claim 12, in which the means for generating is operative to insert the channel side information into the output data such that the channel side information are only used by a high level decoder but are ignored by the low level decoder.

16. Apparatus in accordance with claim 2, which further
comprises an encoder for encoding the first downmix channel
to obtain the signal derived from the first downmix channel
5 or for encoding the second downmix channel to obtain the
signal derived from the second downmix channel.

17. Apparatus in accordance with claim 16, in which the
encoder is a perceptual encoder which includes means for
10 converting a signal to be encoded into a spectral represen-
tation, means for quantizing the spectral representation
using a psychoacoustic model and means for entropy encoding
a quantized spectral representation to obtain an entropy
15 encoded quantized spectral representation as the signal de-
rived from the first downmix channel or the signal derived
from the second downmix channel.

18. Apparatus in accordance with claim 17, in which the
perceptual encoder is an encoder in accordance with MPEG-
20 1/2 layer III (mp3) or MPEG-2/4 advanced audio coding
(AAC).

19. Apparatus in accordance with claim 1, in which the
means for calculating is operative to calculate downmix en-
25 ergy values for the downmix channel or the combined downmix
channel,

30 to calculate an original energy value for the selected
original channel, and

to calculate a gain factor as the channel side infor-
mation, the gain factor being derived from the downmix en-
ergy value and the original energy value.

20. Apparatus in accordance with claim 1, in which the means for calculating is operative to calculate frequency dependent channel side information parameters such that for 5 a plurality of frequency bands, a plurality of different channel side information parameters are obtained.

21. Method of processing a multi-channel audio signal, the 10 multi-channel audio signal having at least three original channels, comprising:

providing a first downmix channel and a second downmix channel, the first and the second downmix channels being derived from the original channels;

15 calculating channel side information for a selected original channel of the original signals such that a downmix channel or a combined downmix channel including the first and the second downmix channel, when weighted using 20 the channel side information, results in an approximation of the selected original channel; and

generating output data, the output data including the channel side information.

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22. Apparatus for inverse processing of input data, the input data including channel side information, a first downmix channel or a signal derived from the first downmix channel and a second downmix channel or a signal derived 30 from the second downmix channel, wherein the first downmix channel and the second downmix channel are derived from at least three original channels of a multi-channel audio signal, and wherein the channel side information are calcu-

lated such that a downmix channel or a combined downmix channel including the first downmix channel and the second downmix channel, when weighted using the channel side information, results in an approximation of the selected 5 original channel, the apparatus comprising:

an input data reader for reading the input data to obtain the first downmix channel or a signal derived from the first downmix channel and the second downmix channel or a signal derived from the second downmix channel and the 10 channel side information; and

a channel reconstructor for reconstructing the approximation of the selected original channel using the 15 channel side information and the downmix channel or the combined downmix channel to obtain the approximation of the selected original channel.

23. Apparatus in accordance with claim 22, further comprising a perceptual decoder for decoding the signal derived from the first downmix channel to obtain the decoded version of the first downmix channel and for decoding the signal derived from the second downmix channel to obtain a 20 decoded version of the second downmix channel.

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24. Apparatus in accordance with claim 22, further comprising a combiner for combining the first downmix channel and the second downmix channel to obtain the combined downmix channel.

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25. Apparatus in accordance with claim 22,

in which the original audio signal includes a left channel, a left surround channel, a right channel, a right surround channel and center channel,

5 wherein the first downmix channel and the second downmix channel are a left downmix channel and a right downmix channel, respectively, and

10 wherein the input data include channel side information for at least three of the left channel, the left surround channel, the right channel, the right surround channel and the center channel,

15 wherein the channel reconstructor is operative

to reconstruct an approximation of the left channel using channel side information for the left channel and the left downmix channel,

20 to reconstruct an approximation for the left surround channel using channel side information for the left surround channel and the left downmix channel,

25 to reconstruct an approximation for the right channel using channel side information for the right channel and the right downmix channel, and

30 to reconstruct an approximation for the right surround channel using channel side information for the right surround channel and the right downmix channel.

26. Apparatus in accordance with claim 22, in which the
channel reconstructor is operative to reconstruct an ap-
proximation for the center channel using channel side in-
formation for the center channel and the combined downmix
5 channel.

27. Method of inverse processing of input data, the input
data including channel side information, a first downmix
channel or a signal derived from the first downmix channel
10 and a second downmix channel or a signal derived from the
second downmix channel, wherein the first downmix channel
and the second downmix channel are derived from at least
three original channels of a multi-channel audio signal,
and wherein the channel side information are calculated
15 such that a downmix channel or a combined downmix channel
including the first downmix channel and the second downmix
channel, when weighted using the channel side information,
results in an approximation of the selected original chan-
nel, the method comprising:

20 reading the input data to obtain the first downmix
channel or a signal derived from the first downmix channel
and the second downmix channel or a signal derived from the
second downmix channel and the channel side information;
25 and

reconstructing the approximation of the selected
original channel using the channel side information and the
downmix channel or the combined downmix channel to obtain
30 the approximation of the selected original channel.

28. Computer program having a program code for performing
a method of processing a multi-channel audio signal, the

multi-channel audio signal having at least three original channels, comprising:

5 providing a first downmix channel and a second downmix channel, the first and the second downmix channels being derived from the original channels;

10 calculating channel side information for a selected original channel of the original signals such that a downmix channel or a combined downmix channel including the first and the second downmix channel, when weighted using the channel side information, results in an approximation of the selected original channel; and

15 generating output data, the output data including the channel side information.

29. Computer program having a program code for performing a method for inverse processing of input data, the input data including channel side information, a first downmix channel or a signal derived from the first downmix channel and a second downmix channel or a signal derived from the second downmix channel, wherein the first downmix channel and the second downmix channel are derived from at least 25 three original channels of a multi-channel audio signal, and wherein the channel side information are calculated such that a downmix channel or a combined downmix channel including the first downmix channel and the second downmix channel, when weighted using the channel side information, results in an approximation of the selected original channel, the method comprising:
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reading the input data to obtain the first downmix channel or a signal derived from the first downmix channel and the second downmix channel or a signal derived from the second downmix channel and the channel side information;
5 and

reconstructing the approximation of the selected original channel using the channel side information and the downmix channel or the combined downmix channel to obtain
10 the approximation of the selected original channel.